

## XFP 10G 1310nm Single mode Optical Transceiver



### Description

The BlueOptics® BO31J13610D XFP transceiver is a high performance, cost effective module supporting a data rate up to 10Gbps with 10 Kilometer link length on single mode fiber.

BlueOptics® transceivers are 100% compliant with XFP Multi-Source Agreement (MSA).

All BlueOptics® XFP transceivers are always equipped with digital diagnostic function compliant to MSA SFF-8472.

Using digital diagnostic, BlueOptics® XFP transceivers provide the following real time information:

- Supply voltage
- Laser bias current
- Laser average output power
- Laser received input power
- Temperature

The transceiver consists of five sections: A DFB transmitter, a PIN photodiode, a trans-impedance preamplifier (TIA), the LD Driver and the digital diagnostic function.

### Applications

- ✓ 10G Ethernet – IEEE802.3ae
- ✓ 10G Fibre Channel – 1413-D
- ✓ SONET/ SDH – OC192/SDH-64
- ✓ OC-192 over FEC - G.709
- ✓ 10GBs Ethernet over G.709

### Features

- ✓ 9.95Gb/s to 11.3Gb/s serial optical interface
- ✓ DFB laser transmitter
- ✓ PIN photo-detector
- ✓ Hot-pluggable XFP footprint compliant to INF-8077
- ✓ Duplex LC/UPC type pluggable optical interface
- ✓ 2-wire interface for management
- ✓ Metal enclosure, for lower EMI
- ✓ RoHS compliant and lead-free
- ✓ Single +3.3V power supply
- ✓ Compliant with SFF-8472
- ✓ Case operating temperature
  - Commercial: 0°C to +70°C
  - Extended: -10°C to +80°C
  - Industrial: -40°C to +85°C

## Warnings

**Handling Precautions:** This device is susceptible to damage as a result of electrostatic discharge (ESD). A static free environment is highly recommended.

**Laser Safety:** Even small radiation emitted by laser devices can be dangerous to human eyes and lead to permanent eye injuries. Be sure to avoid eye contact with direct or indirect radiation.

## Warranty

Every BlueOptics® transceiver comes with a 5 year replacement warranty and lifetime support.

For a warranty inquiry, please contact your CBO sales representative.

This warranty only covers the first user of the equipment.

## Important Notice

Performance figures, data and any illustrative material provided in this data sheet are typical and must be specifically confirmed in writing by CBO before they become applicable to any particular order or contract. In accordance with the CBO policy of continuous improvement specifications may change without notice.

The publication of information in this data sheet does not imply freedom from patent or other protective rights of CBO or others.

Further details are available from any CBO sales representative.

## Installation

Before installation attach an ESD-preventive wrist to ensure not to damage the transceiver or hardware.

BlueOptics® BO31J13610D can be installed in any Small Form Factor Pluggable+ (XFP) port. You can install the BO31J13610D regardless if the system is powered on or off, because it is hot-swappable.

Insert the transceiver into the SFP port and remove the dust cap.

You can now connect your cable.

## Order Information

| Part No.      | Temp.          | DDM |
|---------------|----------------|-----|
| BO31J13610D   | 0°C to +70°C   | ✓   |
| BO31J13610DEX | -10°C to +80°C | ✓   |
| BO31J13610DIN | -40°C to +80°C | ✓   |

## Regulatory Compliance

| Feature                            | Standard                                                | Co.          |
|------------------------------------|---------------------------------------------------------|--------------|
| Electrostatic Discharge (ESD)      | - IEC/EN 61000-4- 2                                     | ✓            |
| Electromagnetic Interference (EMI) | - FCC Part 15 Class B EN 55022<br>- Class B (CISPR 22A) | ✓            |
| Laser Eye Safety                   | - FDA 21CFR 1040.10, 1040.11<br>- IEC/EN 60825-1, 2     | Class 1<br>✓ |
| Component Recognition              | - IEC/EN 60950, UL                                      | ✓            |
| RoHS                               | - 2002/95/EC                                            | ✓            |
| EMC                                | - EN61000-3                                             | ✓            |

**1. Absolute Maximum Ratings**

| Parameter                | Symbol | Min. | Typ. | Max. | Unit |
|--------------------------|--------|------|------|------|------|
| Storage Temperature      | Ts     | -40  |      | 85   | °C   |
| Storage Ambient Humidity | HA     | 5    |      | 95   | %    |

**2. Recommended Operating Conditions**

| Parameter             | Symbol            | Min. | Typ. | Max. | Unit | Note          |
|-----------------------|-------------------|------|------|------|------|---------------|
|                       |                   | 0    |      | 70   |      | BO31J13610D   |
|                       |                   | -10  |      | 80   | °C   | BO31J13610DEX |
|                       |                   | -40  |      | 85   |      | BO31J13610DIN |
| Ambient Humidity      | HA                | 5    |      | 70   | %    |               |
| Transmission Distance |                   |      |      | 10   | KM   |               |
| Coupled Fiber         | Single mode fiber |      |      |      |      | 9/125µm SMF   |

**3. Electrical Interface Characteristics**

| Parameter                      | Symbol     | Min.    | Typ. | Max.    | Unit | Note |
|--------------------------------|------------|---------|------|---------|------|------|
| Power Supply Voltage           | Vcc        | 3.13    | 3.3  | 3.45    | V    |      |
| Signal Input Voltage           | Icc        |         |      | 450     | mA   |      |
| <b>Transmitter</b>             |            |         |      |         |      |      |
| Input differential impedance   | Rin        |         | 100  |         | Ω    | 1    |
| Single ended data input swing  | Vin,pp     | 120     |      | 1000    | mV   |      |
| Transmit Disable Voltage       | VD         | 2.0     |      | Vcc     | V    |      |
| Transmit Enable Voltage        | VEN        | GND     |      | GND+0.8 | V    | 2    |
| Transmit Disable Assert Time   |            |         |      | 10      | µs   |      |
| <b>Receiver</b>                |            |         |      |         |      |      |
| Differential data output swing | Vout,pp    | 600     | 650  | 800     | mV   | 3    |
| Data output rise time          | tr         |         |      | 40      | Ps   | 4    |
| Data output fall time          | tf         |         |      | 40      | Ps   | 4    |
| LOS Fault                      | VLOS fault | Vcc-0.5 |      | VccHOST | V    | 5    |
| LOS Normal                     | VLOS norm  | GND     |      | GND+0.8 | V    | 5    |
| Power Supply Rejection         | PSR        | 100     |      |         | mVpp | 6    |

**Notes:**

1. Internally AC coupled.
2. Or open circuit.
3. Into 100Ω differential termination.
4. 20-80%
5. LOS is an open collector output. Should be pulled up with 4.7KΩ on the host board.
6. All transceiver specifications are compliant with a power supply sinusoidal modulation of 20 Hz to 1.5 MHz up to specified value through the power supply filtering network shown on page 23 of the Small Form - factor Pluggable (SFP) Transceiver Multi Source Agreement (MSA), September 14, 2000.

#### 4. Transmitter Specifications - Optical

| Parameter                           | Symbol                                               | Min. | Typ. | Max. | Unit  | Note      |
|-------------------------------------|------------------------------------------------------|------|------|------|-------|-----------|
| Average Output Power                | P <sub>OUT</sub>                                     | -6   |      | -1   | dBm   |           |
| Extinction Ratio                    | ER                                                   | 3.5  |      |      | dB    |           |
| Center Wavelength                   | λ <sub>C</sub>                                       | 1290 | 1310 | 1330 | nm    | DFB Laser |
| Average Launch power of transmitter | POFF                                                 |      |      | -30  | dBm   |           |
| Transmitter and Dispersion Penalty  | TDP                                                  |      |      | 3.2  | dBm   |           |
| RIN                                 | RIN                                                  |      |      | -128 | dB/Hz |           |
| Output Eye Mask                     | Compliant with IEEE802.3ae<br>(class 1 laser safety) |      |      |      |       |           |

#### 5. Receiver Specifications - Optical

| Parameter                         | Symbol            | Min. | Typ. | Max. | Unit | Note |
|-----------------------------------|-------------------|------|------|------|------|------|
| Input Optical Wavelength          | λ <sub>IN</sub>   | 1270 |      | 1610 | nm   |      |
| Receiver Sensitivity              | P <sub>IN</sub>   |      |      | -15  | dBm  | 1    |
| Input Saturation Power (Overload) | P <sub>SAT</sub>  | 0.5  |      |      | dBm  |      |
| LOS Assert                        | P <sub>A</sub>    | -32  |      |      | dBm  |      |
| LOS De-assert                     | P <sub>D</sub>    |      |      | -18  | dBm  |      |
| LOS Hysteresis                    | P <sub>A-PD</sub> | 0.5  |      |      | dB   |      |

##### Notes:

1. Measured with Light source 1310nm, ER=3.5dB; BER =<10<sup>-12</sup> @PRBS=2<sup>31</sup>-1 non-return-to-zero.

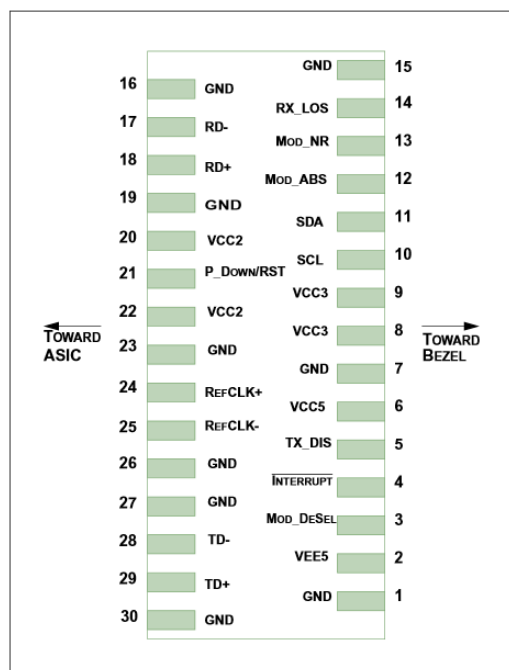
#### 6. XFP to Host Connector Pin Out

| Pin | Symbol    | Name / Description                                                                                                                 | Note |
|-----|-----------|------------------------------------------------------------------------------------------------------------------------------------|------|
| 1   | GND       | Module Ground                                                                                                                      | 1    |
| 2   | VEE5      | Optional -5.2 Power Supply – <i>Optional</i>                                                                                       |      |
| 3   | Mod-Desel | Module De-select; When held low allows the module to respond to 2-wire serial interface commands                                   |      |
| 4   | Interrupt | Interrupt (bar); Indicates presence of an important condition which can read over the serial 2-wire interface                      | 2    |
| 5   | TX_DIS    | Transmitter Disable; Transmitter laser source turned off                                                                           |      |
| 6   | VCC5      | +5 Power Supply – <i>Optional</i>                                                                                                  |      |
| 7   | GND       | Module Ground                                                                                                                      | 1    |
| 8   | VCC3      | +3.3V Power Supply                                                                                                                 |      |
| 9   | VCC3      | +3.3V Power Supply                                                                                                                 |      |
| 10  | SCL       | Serial 2-wire interface clock                                                                                                      |      |
| 11  | SDA       | Serial 2-wire interface data line                                                                                                  | 2    |
| 12  | Mod_Abs   | Module Absent; Indicates module is not present. Grounded in the module.                                                            | 2    |
| 13  | Mod_NR    | Module Not Ready; CBO defines it as a logical OR between RX_LOS and Loss of Lock in TX/RX.                                         | 2    |
| 14  | RX_LOS    | Receiver Loss of Signal indicator                                                                                                  | 2    |
| 15  | GND       | Module Ground                                                                                                                      | 1    |
| 16  | GND       | Module Ground                                                                                                                      | 1    |
| 17  | RD-       | Receiver inverted data output                                                                                                      |      |
| 18  | RD+       | Receiver non-inverted data output                                                                                                  |      |
| 19  | GND       | Module Ground                                                                                                                      | 1    |
| 20  | VCC2      | +1.8V Power Supply – <i>Optional</i>                                                                                               |      |
|     |           | Power Down; When high, places the module in the low power stand-by mode and on the falling edge of P_Down initiates a module reset |      |

|    |         |                                                                                                                                     |   |
|----|---------|-------------------------------------------------------------------------------------------------------------------------------------|---|
|    |         | Reset; The falling edge initiates a complete reset of the module including the 2-wire serial interface, equivalent to a power cycle |   |
| 22 | VCC2    | +1.8V Power Supply – <b>Optional</b>                                                                                                |   |
| 23 | GND     | Module Ground                                                                                                                       | 1 |
| 24 | RefCLK+ | Reference Clock non-inverted input, AC coupled on the host board – <b>Optional</b>                                                  | 3 |
| 25 | RefCLK- | Reference Clock inverted input, AC coupled on the host board – <b>Optional</b>                                                      | 3 |
| 26 | GND     | Module Ground                                                                                                                       | 1 |
| 27 | GND     | Module Ground                                                                                                                       | 1 |
| 28 | TD-     | Transmitter inverted data input                                                                                                     |   |
| 29 | TD+     | Transmitter non-inverted data input                                                                                                 |   |
| 30 | GND     | Module Ground                                                                                                                       | 1 |

## Notes:

1. Module circuit ground is isolated from module chassis ground within the module.
2. Open collector; should be pulled up with 4.7kΩ – 10kΩ on host board to a voltage between 3.15V and 3.6V.
3. Reference Clock input not required. If present, it will be ignored.



Pinout of Connector Block on Host Board

## 7. EEPROM Information

The SFP MSA defines a 256-byte memory map in EEPROM describing the transceivers capabilities, standard interfaces, manufacturer, and other information, which is accessible over a 2 wire serial interface at the 8-bit address 1010000X (A0h).

| Data Address | Field Size (Bytes) | Name of Field              | Contents (Hex)                                        | Description                                                                            |
|--------------|--------------------|----------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------|
| 128          | 1                  | Identifier                 | XX                                                    | Formfactor                                                                             |
| 129          | 1                  | Ext. Identifier            | XX                                                    |                                                                                        |
| 130          | 1                  | Connector                  | XX                                                    |                                                                                        |
| 131-138      | 8                  | Transceiver                | XX XX XX XX XX XX XX                                  | Transmittter Code                                                                      |
| 139          | 1                  | Encoding                   | XX                                                    |                                                                                        |
| 140          | 1                  | BR-Min                     | XX                                                    | Minimum bit rate, units of 100 MBits/s                                                 |
| 141          | 1                  | BR-Max                     | XX                                                    | Maximum bit rate, units of 100 MBits/s                                                 |
| 142          | 1                  | Length (9μm) km            | XX                                                    | Max. link length in KM                                                                 |
| 143          | 1                  | Length (9μm) 100m          | XX                                                    | Max. link length in M                                                                  |
| 144          | 1                  | Length (50μm) 10m          | XX                                                    | Max. link length in M                                                                  |
| 145          | 1                  | Length(62.5μm)10m          | XX                                                    | Max. link length in M                                                                  |
| 146          | 1                  | Length (Copper)            | XX                                                    | Max. link length in M                                                                  |
| 147          | 1                  | Device Tech                | XX                                                    | Device technology                                                                      |
| 148-163      | 16                 | Vendor name                | XX XX XX XX XX XX XX<br>XX XX XX XX XX XX XX<br>XX XX | Vendor name - OEM                                                                      |
| 164          | 1                  | CDR Support                | XX                                                    | CDR Rate Support                                                                       |
| 165-167      | 3                  | Vendor OUI                 | XX XX XX                                              |                                                                                        |
| 168-183      | 16                 | Vendor PN                  | XX XX XX XX XX XX XX<br>XX XX XX XX XX XX XX<br>XX XX | Product Number - depending on Part                                                     |
| 184-185      | 2                  | Vendor rev                 | XX XX XX XX                                           | Vendor revision                                                                        |
| 186-187      | 2                  | Wavelength                 | XX XX                                                 | Transceiver Wavelength                                                                 |
| 188 – 189    | 2                  | Wavelength tolerance       | XX                                                    | Guaranteed range of laser wavelength                                                   |
| 190          | 1                  | Max Case Temp              | XX                                                    | Checksum of bytes 0-62                                                                 |
| 191          | 1                  | CC BASE                    | XX                                                    | Checksum of bytes 0-62                                                                 |
| 192-195      | 4                  | Power Supply               | XX XX XX XX                                           | Power supply current requirements and max power dissipation                            |
| 196-211      | 16                 | Vendor SN                  | XX XX XX XX XX XX XX<br>XX XX XX XX XX XX XX<br>XX XX | Part serial number                                                                     |
| 212-219      | 8                  | Vendor date code           | XX XX XX XX XX XX 20<br>20                            | Year, Month, Day                                                                       |
| 220          | 1                  | Diagnostic Monitoring Type | XX XX XX XX XX XX 20<br>20                            | Year, Month, Day                                                                       |
| 221          | 1                  | Enhanced Options           | XX                                                    | Indicates which optional enhanced features are implemented (if any) in the transceiver |

|         |    |                 |                                                                                                             |                                                  |
|---------|----|-----------------|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| 222     | 1  | Aux Monitorin   | XX                                                                                                          | Defines quantities reported by Aux. A/D channels |
| 223     | 1  | CC_EXT          | XX                                                                                                          | Check code for the Extended ID Fields            |
| 224-255 | 32 | Vendor Specific | XX XX XX XX XX XX XX<br>XX XX XX XX XX XX XX<br>XX XX XX XX XX XX XX<br>XX XX XX XX XX XX XX<br>XX XX XX XX |                                                  |

## 8. Digital Diagnostics / Digital Optical Monitoring

The transceiver provides serial ID memory contents and diagnostic information about the present operating conditions by the 2-wire serial interface (SCL, SDA).

The diagnostic information with internal calibration or external calibration are all implemented, including received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring.

## 9. Mechanical Specifications (Unit: mm)

